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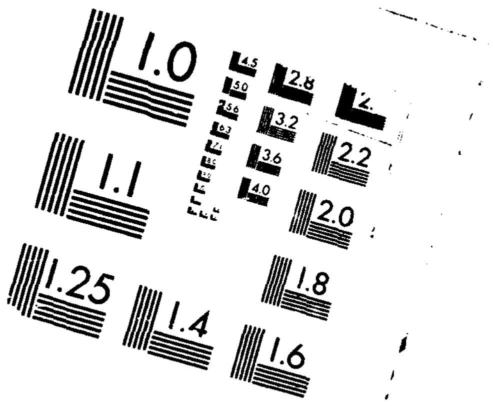

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STUDENT REPORT

SOVIET SPACE PROGRAM
HANDBOOK

MAJOR ROY LONGSTAFFE 88-1610

"insights into tomorrow"

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This study establishes the need for a handbook on the Soviet space program. The handbook itself is divided into four sections. The first section describes the three Soviet space launch sites. The second section describes the operational Soviet space launch vehicles including their dimensions, capabilities, and payloads. Each major Soviet satellite program is then described in detail in the third section. Included here are orbital parameters, constellation sizes and phasings, mission profiles, and vehicle descriptions. And finally, the handbook contains several useful appendices such as launch azimuth vs. inclination graphs for each launch site, a geosynchronous coverage schematic, and several historical analyses.

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PREFACE

This study establishes the need for a handbook on the Soviet space program. The handbook is designed to meet the operational requirements of US space operations officers. It should be useful in a wide variety of applications including threat analysis, spacetrack, and attack warning. The author wishes to thank Lt Col Curt Cochran and Major Bruce Thieman for their assistance and support in completing this project.

ABOUT THE AUTHOR

Major Longstaffe has an extensive background in space operations. His first assignment as an Orbital Analyst Leader at NORAD's Space Defense Center was followed by two years in Range Operations at the Air Force Satellite Control Facility. Then, after graduating from Squadron Officer School in 1979, he began the first of two field tours. He has a total of seven years site experience, including four years in England and, most recently, three years as Mission Director and later Deputy Director of Operations at a site in Colorado. Major Longstaffe is a 1975 graduate of the University of Florida with a Bachelor of Science in Mathematics and a 1979 graduate of the University of Northern Colorado with a Master of Science in Business Management.

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Chapter One

INTRODUCTION

This study will establish the need for a handbook on the Soviet space program. It will describe exactly what's needed and why, assess the resources available, and define how the handbook should be structured to meet the requirement. The handbook will be designed specifically for US space operations officers, but it will also have many broader applications.

The Soviets spend an estimated $35 billion a year on space (2:24). They launch more boosters, operate more satellites, and log more man-hours in space than all the other nations of the world combined.

> The Soviets possess the largest space logistics base and infrastructure in the world. It includes launch pads, numerous mission control sites, and an entire fleet of Space Event Support Ships providing worldwide spacecraft tracking and recovery capability. This system allows them to sustain a vigorous launch rate of approximately 100 launches a year, and--when combined with the world's largest and most active production lines for boosters and satellites--gives them a superior space system replenishment capability (1:76).

In 1987, the Soviet's conducted 95 space launches--the US had eight. In addition, some of their launches put as many as eight satellites in orbit at a time bringing the total number of payloads placed in orbit last year to 111--and none of those figures are records. Today they maintain about

150 active, usable payloads on orbit at any one time. By the mid-1990's, that number's expected to pass the 200 mark -- and at least 90 percent of those are military related (3:53). "Soviet space-based capabilities are already well integrated into their ground, naval, and air forces to support the needs of terrestrial military commanders" (1:76).

After a decade of US mismanagement and misfortune, there are many who believe the Soviets are today ahead of us in space. According to General Robert T. Herres, Vice Chairman of the Joint Chiefs of Staff and former commander of the US Space Command, "Taken together, already operational and future Soviet space capabilities are a cause for genuine concern" (1:77).

The first step in addressing that concern is awareness. Even though this handbook was designed primarily with a specific target audience in mind, it also fills a much larger role. The Soviet space program is not solely the concern of space and intelligence officers -- it's the concern of all officers. It's important to understand Soviet space systems and how they support the Soviet military force structure. It's important to understand what they can and can not do and how their space assets can be used against us both in times of peace and times of war. If you're an officer with a carrier battle group, it's important to understand RORSAT's (Radar Ocean Reconnaissance Satellites) and EORSAT's (ELINT Ocean Reconnaissance Satellites) and to know that if you use

electronic countermeasures to counter the active radar of the RORSAT, your electronic emissions lay you open for detection by the EORSAT. That kind of information is available in this handbook. If you're a ground commander, it's important to understand Soviet photo reconnaissance satellites and Soviet ELINT (electronic intelligence) satellites--to know their capabilities and how to counter them. That kind of information's available here also. And if you're an Air Force support officer, it's important to understand the Soviet ASAT (anti-satellite) program and the threat it may pose to your space-based communications, navigation, and weather support. And that information's available here.

And, no less important, the inverse also applies. Many US space programs are highly classified and compartmented. The average officer in the field has very limited insight into their functions and capabilities. There's good reason for this, but by studying the Soviet program, that officer can gain a better understanding of space and not only how Soviet space systems could be used against him, but by induction, how US space assets might be used to support him in his particular mission. Parallels between GPS (Global Positioning System) and GLONASS (Global Navigation Satellite System), and STS (Space Transportation System) and the Soviet shuttle will be obvious, but inferences about US reconnaissance and surveillance programs based on their Soviet counterparts will also be enlightening.

And, for perhaps the first time ever, enough information is available at an unclassified level to put such a handbook together. Years of secrecy are slowly being unravelled and declassified -- not only by our own government, but by the Soviets as well. Just five years ago, the Soviets hadn't even officially acknowledged the existence of Plesetsk -- the world's busiest spaceport. Last year, they were offering their SL-12 booster for commercial use and providing technical details on its capabilities to the western press. The US Department of Defense now publishes annual summaries of the Soviet space program in its Soviet Military Power series. And there's even talk about a joint US-Soviet mission to Mars. The information is available, but it does not exist in a format that meets our needs. Chapter two of this study will define those needs and establish exactly what's required to satisfy them.

Chapter Two

WHAT'S NEEDED

Even though this handbook has much broader applications as outlined earlier, it is tailored to a specific target audience: the many and diverse space operations and intelligence related units located throughout the world. The network joining these units is not yet complete. Some of them have pieces of this information; some have none at all. With others, it's spread out amongst several sources. In most cases, it's not in a practical or usable format. The bottom line is there is no single document of this kind available to them and they're the people who have call for it on a daily basis. They are the target audience. The handbook is written with them in mind and tailored to their needs. It attempts to identify a universal core of information -- a common, unclassified union of many disjoint sets which simply does not exist today.

The missions of these units are diverse and, in most cases, classified -- and therefore beyond the scope of this paper. The actual mission requirements cannot be discussed. The common core of information on the Soviet space program useful in carrying out those missions, however, can be discussed.

The handbook should include information on four basic areas: Soviet space launch sites, space launch vehicles, major satellite programs, and useful appendices. That information needs to be in a user-friendly format with cross-referencing throughout.

The launch site section needs to include the location of the site, boosters and payloads launched from it, and pertinent background information. The launch vehicle section needs to identify which sites they're launched from, what payloads they launch, and all relevant specifications and background material available on the boosters themselves. The satellite section should list launch site and booster, mission, orbital parameters, and vehicle description. And the appendices should contain specially tailored tools to help these people do their jobs: launch azimuth to inclination conversion plots built for each Soviet launch site and a geosynchronous coverage schematic for example. These things are based on simple scientific principles and will be useful in a wide variety of applications but the sad truth is that, at most of the units that have use for them, they simply do not exist.

This handbook is designed to answer questions or solve problems where today the information either isn't available or doesn't exist in a usable format. In section three it can tell you where all the Soviet geosynchronous satellites are located and in section four it can tell you what their coverage is. It can help you distinguish between EORSAT's and RORSAT's

or between different generation photo reconnaissance satellites based on their orbital parameters.

In working through an unannounced Soviet launch, it can identify the launch site if all you have are the coordinates, the possible payloads if all you have is the booster type, and the inclination if all you have is the launch azimuth. Then taking the list of possible payloads and eliminating those that don't match the inclination, it can narrow the problem even further. Then cross-referencing other information as it becomes available against different sections of the handbook should quickly give a fairly complete picture of the situation. There is no comparable tool designed to work these kinds of scenarios available on the markey today.

The information's out there, but it does not exist in a format that meets our needs -- a format designed with the military space operations officer in mind. It's spread out over probably a thousand different sources, but it is there. It just needs compiling and formatting. "What all of this means is that with effort one can construct a combined worksheet tabulation with a considerable amount of information about space flights, but no single document gives a complete record" (4:119). The next chapter will discuss those sources and assess what information's available to meet the requirements.

Chapter Three

WHAT'S AVAILABLE

Surprisingly, the volume of information on this subject is staggering. Compiling this information into a usable format is the real challenge. The majority of the information comes from the Soviets themselves -- from Soviet news releases, public displays, and literature on the subject. Other sources are notification and registration requirements under international law, and specifications the Soviets have filed and validated in claiming for world records. On the American side, much of this information has been released or confirmed by DOD, NORAD, and other agencies. Most of it is part of the public record. Congressional subcommittee reports address each Soviet space launch including dates, times, launch site, orbital parameters, and mission assessment. Various organizations throughout the world do a very meticulous job of tracking the Soviet space effort including the Royal Aircraft Establishment and the Kettering Group in England, Dr. Sheldon in the Library of Congress, and dozens of magazines and periodicals. "The reason for discussing so fully all these scattered sources of information is that they lie at the heart of unclassified systematic study of world space flight activity, based upon scientifically ascertainable facts, information which reveals much of the

purpose of flights even if none is announced" (4:120).

Thirty years of news releases in Pravda and articles in Soviet magazines are now available to give a clear picture of the Soviet space program. In 1967, the SL-4 was displayed at the Paris Air Show and its specifications described in considerable detail. Today, Americans watch SL-4 launches live on CNN. Over the years, the Soviets have displayed a wide range of satellites at the Paris Air Show -- Molniya in 1973 and a full-scale mock-up of the Mir/Kvant/Soyuz-TM complex in 1986 to name just two. During the first Mir mission, key events were often announced in advance and some events were even broadcast live. Immediately following the first successful launch of their new Energia space launch vehicle in 1987, the Soviets made films available of the launch. They now offer their SL-12 space launch vehicle for commercial use -- in competition with Ariane and the US Shuttle. And most of their operational launch vehicles and many of their satellites are on public display in the Moscow Space Museum.

A lot of information is available from international agencies. Soviet claims for world space records and launch vehicle specifications are on file with the FAI (Federation Aeronautique Internationale) in Paris. The 1967 Outer Space Treaty requires the Soviets to register all space launches with the United Nations. Frequencies and orbital positions for geosynchronous communications satellites must be filed with the International Frequency Registration Board -- in

advance.

Much of their technology is US derived. "Soviet shuttle development has been heavily dependent on US orbiter propulsion, computer, materials, and airframe design technology. By using US technology and designs, the Soviets were able to produce an orbiter years earlier, and at far less cost, than if they had depended solely on their own technology" (3:54). Soviet GLONASS satellites are virtually identical to our GPS satellites -- flying the same orbits and using the same digital processing system.

A lot of information on the Soviet space program is part of the public record. Congressional subcommittee reports give painstakingly detailed accounts of the approach they use in compiling it and make a compelling and lengthy argument about it being unclassified.

> There are often some people in any institution who have little incentive to release information, and who would shift the burden of proof by asking why the public or the profession at large needs to know something. They imagine all the ways in which disclosure might either harm information collection efforts or destabilize a status quo where things go along comfortably unless someone makes a situation an issue. Some of these concerns are legitimate, and deserve full consideration. Therefore, the kind of analyses undertaken in this study are based upon unclassified sources. They are based upon sources which are either voluntarily published by the launching state, or are drawn from published data acquired by tracking apparatus so fundamental to all space activity as to be beyond reasonable complaint or countermeasure (4:120).

DOD, NORAD, and other official sources are now making a concerted effort to educate the public on the nature of the

Soviet space program.

Finally, much of this information is based on fundamental scientific principles and collection methods available throughout the world. Probably the best example of earlier intransigence in this area was in 1966 when the Soviet cosmodrome at Plesetsk first became operational. Even though unclassified US, British, and French satellite tracking quickly confirmed its existence (the Soviets didn't acknowledge it until 1983), it was left to British school boys at the Kettering Grammar School in London to determine its location and announce it to the world.

> Finally, it is hoped that this account of sources and their interpretation may contain a few object lessons on what information can be controlled and what cannot by its very nature. This study left the distinct impression during its preparation that some very ordinary information that need not be classified and cannot be hidden from other governments, whether involving Soviet or United States flights is made extremely hard to collect systematically (4:117).

There are still some holes in the story, but more are being filled everyday.

Chapter Four

HOW THE HANDBOOK IS STRUCTURED

This handbook is structured so that the user can start at any point in the handbook, with whatever information he has available to him at the time, and work through to solve a problem, answer a question, or handle any given situation.

The launch site section answers the most commonly asked questions right up front. What are the coordinates of the site? What boosters are launched from there? What payloads might I be dealing with? Elaborating on the example in chapter two, even if all you have is a set of coordinates, you've already started to narrow the problem and can take preliminary actions until more information becomes available. Then for reference, or less time critical situations, it provides pertinent background information on these sites as well. And, by no means is this proposed to be a complete listing. This is just a foundation to be highlighted or supplemented with information tailored to the specific user and mission at hand.

The launch vehicle section is also capable of being used as a stand-alone document. It answers questions like: Where's this booster launched from? What payloads does it launch? How many stages does it have? What are the burn times? What kind of propellant does it use? And what's the weight, thrust,

dimensions, and payload capacity? Then for reference, it includes relative historical and background information. So that once you know the booster type, you can narrow your payload options and continue to tailor your response. Continuing with the example, you know when to expect staging and have some historical information available that might help in carrying out your mission.

By this point, the answer to your problem is in sight and you start to have enough pieces of the puzzle to get to it. Continual cross-referencing between information in the payload section and the information already available should provide the solution. The payload section starts becoming redundant: launch site and launch vehicle. The mission of that particular payload is spelled out in simple terms: COMM, NAV, etc. It tells you right up front if the satellite's maneuverable and what its orbital parameters are. Only then does it get into vehicle description, size, and weight; detailed mission profile; constellation size and phasing; and relevant historical and background information.

And finally, the handbook contains useful appendices. There are maps showing the launch sites and scale drawings of the space launch vehicles. Since much of the civilian literature on the subject uses different nomenclature, there are conversion tables for the civilian and DOD designation systems for launch vehicles. There is historical information on launches per year and mission types. There's launch azimuth

versus inclination charts for each launch site and instructions on how to use them. And there's a geosynchronous coverage schematic and instructions on how to use it.

All of this information is available. In some cases, it just needs compiling from raw data--in others, deriving from standard formulas. Much of what's available on the subject is bogged down with historical details that are often completely irrelevant from an operational point of view. Other sources are out of date and therefore equally worthless. Nowhere does this information exist in this format designed to meet these requirements.

Chapter Five

WHAT STILL NEEDS TO BE DONE

This handbook fills an existing need, but without a continuing effort to keep it current, it will rapidly become just a snapshot in time -- a handbook on the Soviet space program as it existed in early 1988. Just as a handbook written a couple of years ago would need updating with Mir, Energia, and the SL-16, this handbook will one day need updating with a full-scale spaceplane or sixth generation photo reconnaissance satellite. And just as the SL-7 and Vostok belong more in a history book than an operational handbook, the SL-3 and Salyut may one day have to be deleted also. Without periodic updates, ten years from now this handbook will be about as valuable as a ten year old handbook on the subject would be to us today. The importance of current information in such a rapidly changing field can not be over emphasized. Furthermore, and for obvious reasons, the custodian for this document should be an organization as opposed to an individual -- with US Space Command as probably the logical choice.

As outlined earlier, more information's becoming available on the Soviet space program all the time. As it does, more of the holes in the handbook can be filled. Things

have come a long way in the last few years, but there's still a long way to go before the picture's complete.

Also, it should be noted, even though this handbook's the result of an extensive study, it was by no means exhaustive. The study becomes almost self-perpetuating, with each new source referencing or leading to several others. It was simply beyond the scope of this effort to completely sift through 30 years of literature on the subject. Matching the requirements against the amount of unclassified information currently available on the subject, the handbook is probably 90 percent complete with an exponentially diminishing rate of return for anything beyond that.

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SOVIET SPACE PROGRAM HANDBOOK

PREFACE

This handbook is designed to meet the operational requirements of US military officers. It's divided into four sections: Soviet space launch sites, space launch vehicles, major satellite programs, and appendices. A bibliography of the documents used to create this handbook is also included. The launch site and satellite sections are organized alphabetically and the launch vehicle section is organized numerically. Missing fields in the satellite section indicate data that was either unavailable or not applicable. It's hoped the information in this handbook will lead to a greater understanding of the Soviet space program as it pertains to the US military audience and that the handbook will be useful in meeting mission requirements.

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FIGURES

SPACE LAUNCH SITES

KAPUSTIN YAR
(KY)

Coordinates: N48.4 E45.8

Launch Vehicles: SL-8

Payloads: Radar Calibration, Intercosmos, Spaceplane

Kapustin Yar is the smallest of the three Soviet launch complexes. It's used mainly for suborbital reentry tests, but it also launches one or two orbital flights a year -- mainly radar calibration and routine scientific satellites. It is also the launch site used for the Soviet subscale spaceplane tests.

Kapustin Yar is located near the city of Volgograd about 965 km southeast of Moscow. The Soviets officially refer to it as the Volgograd Station. It was known to be a military testing range as far back as the mid-1950's and Cosmos 1 was launched from there in 1962. The complex is 96 by 72 km in area and roughly equivalent to our Wallops Island.

Sources: 31, 33, 34

PLESETSK
(PK)

Coordinates: N62.8
E40.1

Launch Vehicles: SL- 3
SL- 4
SL- 6
SL- 8
SL-14

Payloads: BIOSAT, Early Warning, Earth Resources, ELINT, Geodetic, Intercosmos, METSAT, Molniya, MPCS (6 Pack), MPCS (8 Ball), NAVSAT, Photo Recon, RADSAT, SPCS

Plesetsk is the Soviet's primary military space launch site and the world's busiest spaceport. It's used for missions which require higher inclinations than those achievable from Tyuratam -- due mainly to the launch azimuth constraints associated with the risk of first stage reentries over populated areas. The first space launch from Plesetsk occurred in 1966. It was 1983 however before the Soviets officially acknowledged the existence of the site.

Plesetsk is located about 170 km south of Archangel. Due to its high northern latitude, even economically efficient due east launches from Plesetsk still provide coverage of most the inhabited areas of the world. Plesetsk is the equivalent of our Vandenberg.

Sources: 5, 31, 33, 34

TYURATAM
(TT)

Coordinates:	N45.6	Launch Vehicles:	SL- 3	SL-12
	E63.4		SL- 4	SL-13
			SL- 6	SL-16
			SL-11	SL- W

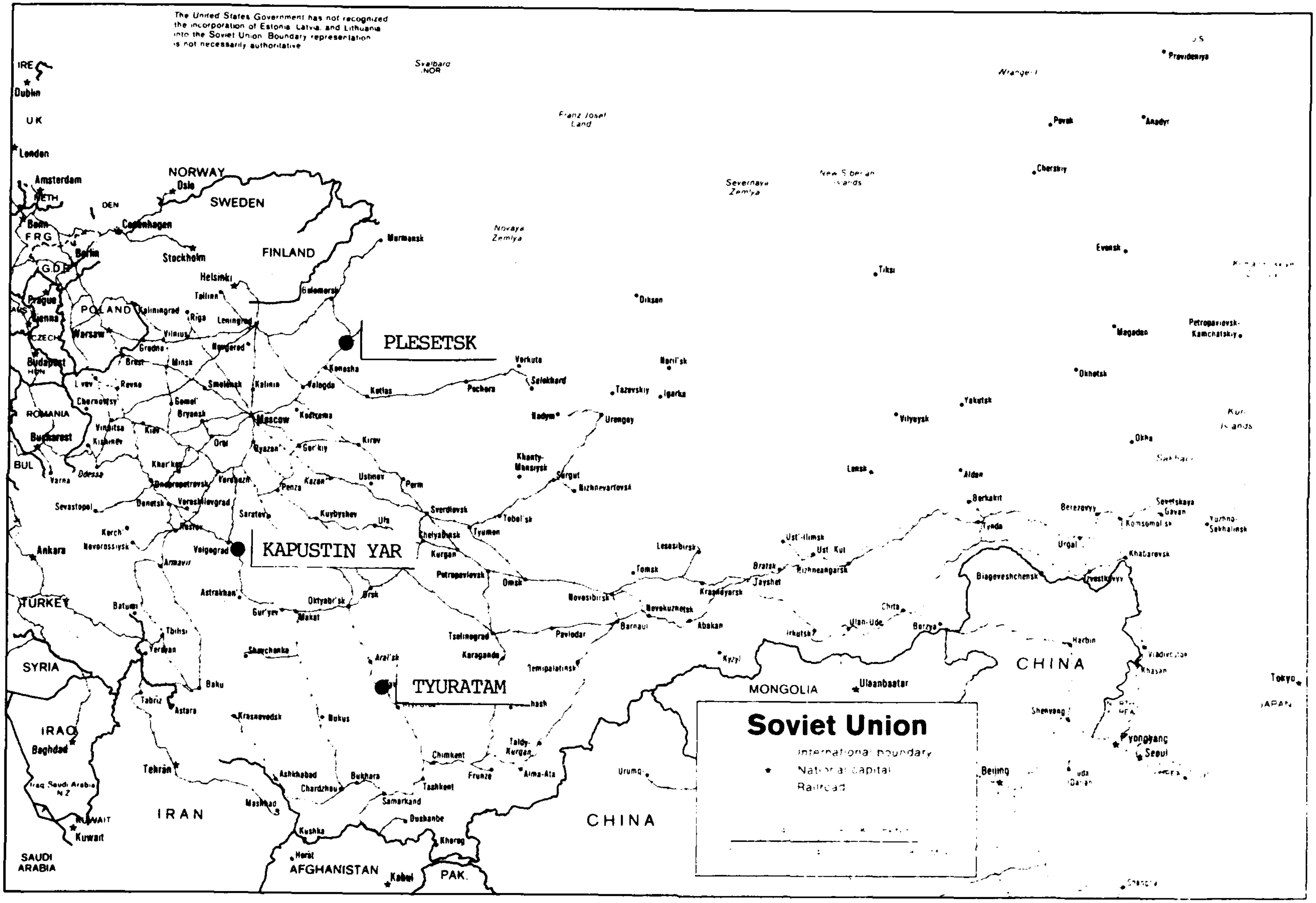
Payloads:	ASAT	Mir
	Cos 929 Type	Molniya
	Cos 1603 Type	Photo Recon
	Cos 1700 Type	Prognoz
	Ekran	Progress
	EORSAT	Raduga
	FOBS	RORSAT
	GLONASS	Salyut
	Gorizont	Soyuz
	Interplanetary Probes	Space Shuttle
	Kvant	Stasionar
	METSAT	Venera

Tyuratam is the largest space launch site in the world (as large as nine Kennedy Space Centers). It's the only one of the three cosmodromes that launches satellites into equatorial orbits, and, in addition to a wide variety of military and scientific satellites, all Soviet manned flights and unmanned interplanetary missions are launched from there. Sputnik 1 and Yuri Gagarin were both launched from Tyuratam.

Tyuratam is located in the southern part of Soviet Central Asia just east of the Aral Sea. It's officially called the Baikonur Cosmodrome, although the town of Baikonur actually lies 370 km to the northeast. This was the result of an early attempt to mislead the public since Baikonur did in fact lie along the initial ground trace of the first Sputnik. After the second Sputnik launch however, the site was quickly confirmed to be near the town of Tyuratam, now called Leninsk (pop. 55,000). The cosmodrome, which has over 80 launch pads, is spread out over a region more than 80 by 160 km in size. It's latest addition is a new 15,000 ft shuttle recovery runway. Tyuratam is functionally equivalent to our Kennedy Space Center.

Sources: 4, 5, 31, 33, 34

SOVIET SPACE LAUNCH SITES



SPACE LAUNCH VEHICLES

SL-3

Launch Sites: TT, PK

Payloads: METEOR

Stages: 2 (SS-6 Sapwood plus a Luna 3rd stage)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
Core	28.0m	3.0m	1	4
Strap-ons (4)	19.0	3.0	4	16
2nd Stage	3.1	2.6	1	1
Shroud	6.9	2.8	-	-
Overall	38.0		6	21

	Engine Designator	Fuel	Oxidizer	Burn Time
Core	RD108	Kerosene	LOX	320 sec
Strap-ons	RD107	Kerosene	LOX	140

Lift-off weight: 290,000 kg
Lift-off thrust: 410,000 kg
Payload capacity: 6300 kg to LEO (180 km)

Background: The SL-3 was first launched in 1959. In 1961, this booster put the first man (Yuri Gagarin) in space. It consists of an SS-6 Sapwood core vehicle with four strap-on boosters plus a Luna third stage. The core vehicle has four main thrust chambers and four verniers. The strap-ons each have four main chambers and two verniers. The 20 total thrust chambers do not gimbal, but instead rely on smaller control engines (verniers) for correcting the attitude of the vehicle. The second stage consists of a single chamber engine with 10,000 kg of thrust. The SL-3 has not been launched since 1985.

Sources: 4, 31, 32

SL-4

Launch Sites: TT, PK

Payloads: BIOSAT, Earth Resources, Photo Recon, Progress, Soyuz

Stages: 2 (SS-6 Sapwood plus a Venera 3rd stage)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
Core	28.0m	3.0m	1	4
Strap-ons (4)	19.0	3.0	4	16
2nd Stage	8.0	2.6	1	4
Shroud	6.9*	2.8*	-	-
Overall	42.9*		6	24

	Engine Designator	Fuel	Oxidizer	Burn Time
Core	RD108	Kerosene	LOX	320 sec
Strap-ons	RD107	Kerosene	LOX	140 sec

Lift-off weight: 310,000 kg
Lift-off thrust: 420,000 kg
Payload capacity: 7500 kg to LEO

Background: The SL-4 was first launched in 1963. It has the same first stage as the SL-3. The second stage consists of a four chamber engine with 30,000 kg of thrust. The SL-4 is currently the only operational manned space launch vehicle in the Soviet inventory.

* The Soyuz version has a 13.3 x 3.0 meter shroud and a 49.3 meter overall length.

Sources: 4, 31, 32

SL-6

Launch Sites: TT, PK

Payloads: Early Warning, Molniya, Prognoz

Stages: 3 (SS-6 Sapwood, a Venera 3rd stage, and an escape stage)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
Core	28.0m	3.0m	1	4
Strap-ons (4)	19.0	3.0	4	16
2nd Stage	8.0	2.6	1	4
3rd Stage	3.1	2.6	1	1
Shroud	4.9	2.9	-	-
Overall	44.0		7	25

	Engine Designator	Fuel	Oxidizer	Burn Time
Core	RD108	Kerosene	LOX	320 sec
Strap-ons	RD107	Kerosene	LOX	140 sec

Lift-off weight: 310,000 kg
Lift-off thrust: 420,000 kg
Payload capacity: 2100 kg to elliptical orbit

Background: The SL-6 was first launched in 1961. The first two stages are the same as the SL-4. The third stage (escape stage) appears to be a version of the SL-3 second stage.

Sources: 4, 31, 32

SL-8

Launch Sites: PK, KY

Payloads: ASAT target, Intercosmos, MPCS, NAVSAT, RADSAT, Spaceplane, SPCS

Stages: 2 (SS-5 Skean plus a restartable 2nd stage)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
1st Stage	19.8m	2.5m	1	2
2nd Stage	8.4	2.5	1	?
Shroud	3.4	2.5	-	-
Overall	31.6	2.5	2	?

	Engine Designator	Fuel	Oxidizer	Burn Time
1st Stage	RD216	UDMH*	Nitric Acid	170 sec
2nd Stage	?	?	?	?

Lift-off weight: 120,000 kg
Lift-off thrust: 160,000 kg
Payload capacity: 1700 kg to LEO

Background: The SL-8 was first launched in 1964. It consists of an SS-5 Skean IRBM first stage plus a restartable second stage. The second stage is used for placing payloads in higher circular orbits from the apogee of an elliptical transfer orbit. The SL-8 is equivalent to the US Thor-Delta.

* UDMH = Unsymmetrical Dimethylhydrazine

Sources: 4, 31, 32

SL-11

Launch Site: TT

Payloads: ASAT, EORSAT, FOBS, RORSAT

Stages: 3 (2 stage adaption of the SS-9 Scarp plus a maneuvering stage)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
1st Stage	20.7m	3.0m	1	6
2nd Stage	9.0	3.0	1	2
3rd Stage	6.0	3.0	1	?
Shroud	9.0	3.0	-	-
Overall	44.7	3.0	3	?

	Engine Designator	Fuel	Oxidizer	Burn Time
1st Stage	?	?	?	?
2nd Stage	RD219	UDMH	Nitric Acid	125 sec
3rd Stage	?	?	?	?

Lift-off weight: 180,000 kg
Lift-off thrust: 280,000 kg
Payload capacity: 4000 kg to LEO

Background: The SL-11 was first launched in 1966. It is a two stage adaption of the SS-9 Scarp ICBM plus a "maneuvering" stage. The US equivalent to the SL-11 is the Atlas-Centaur.

Sources: 4, 31, 32

SL-12

Launch Site: TT

Payloads: COS 1603 Type Heavy ELINT, COS 1700 Type Data Relay, Ekran, GLONASS, Gorizont, Raduga, Venera

Stages: 4 (3 stages plus an apogee motor)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
Core	24.0m	4.0m		
Strap-ons (6)	20.0	4.0	6	6
2nd Stage	11.0	4.0	1	4
3rd Stage	5.0	4.0	1	1
4th Stage	5.5	4.0		
Shroud		4.0	-	-
Overall	~58.0	4.0		

	Engine Designator	Fuel	Oxidizer	Burn Time
Core				
Strap-ons	RD253	UDMH	N_2O_4*	130 sec
2nd Stage				
3rd Stage				
4th Stage		Kerosene	LOX	600+

Lift-off weight: 680,000 kg
Lift-off Thrust: 900,000 kg
Payload capacity: 22,700 kg to LEO (2100 kg to geosynch)

* N_2O_4 = Nitrogen Tetroxide

Background: The SL-12 was first launched in 1967. It is also known as the PROTON. The SL-12 can launch 22,700 kg to low earth orbit -- 4500 kg more than the Saturn 1B. In 1983, the Soviets offered to allow the SL-12 to be used commercially in competition with Ariane and the US Space Shuttle. So far however, there have been no takers -- largely because most Western satellites contain US technology and the US will not give permission for that technology to enter the Soviet Union. In 1984, an SL-12 launched Cosmos 1603, the Soviet's largest ever military satellite.

Sources: 2, 4, 31, 32

SL-13

Launch Site: TT

Payloads: MIR, Salyut, Space Station Modules

Stages: 3 (SL-12 minus the escape stage)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
Core	24.0m	4.0m		
Strap-ons (6)	20.0	4.0	6	6
2nd Stage	11.0	4.0	1	4
3rd Stage	5.0	4.0	1	1
Shroud	~15.0	4.0	-	-
Overall	~55.0	4.0		

	Engine Designator	Fuel	Oxidizer	Burn Time
Core				
Strap-ons	RD253	UDMH	N_2O_4	130 sec
2nd Stage				
3rd Stage				

Lift-off weight: 670,000 kg
Lift-off thrust: 900,000 kg
Payload capacity: 19,500 kg to LEO

Background: The SL-13 was first launched in 1968. It is used to launch Soviet space stations and space station modular components. It is identical to the first three stages of the SL-12 and, like the SL-12, is launched only from Tyuratam.

Sources: 2, 4, 31, 32

SL-14

Launch Site: PK

Payloads: ELINT, Geodetic, Meteor, MPCS Follow-on (6-Pack)

Stages: 3 (SS-9 Scarp derivative)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
1st Stage	20.7m	3.0m	1	6
2nd Stage	9.0	3.0	1	2
3rd Stage	6.0	3.0		

	Engine Designator	Fuel	Oxidizer	Burn Time
1st Stage				
2nd Stage	RD219	UDMH	Nitric Acid	125 sec
3rd Stage				

Lift-off weight: 190,000 kg
Lift-off thrust: 280,000 kg
Payload capacity: 5500 kg to LEO

Background: The SL-14 was first launched in 1977. It is the replacement for the SL-3. The first two stages of the SL-14 are identical to those on the SL-11. However, whereas the SL-11 is launched only from Tyuratam, the SL-14 is launched only from Plesetsk. The SL-14 is roughly equivalent to the US Atlas-Centaur.

Sources: 4, 31, 32

SL-16

Launch Site: TT

Payloads: medium weight Cosmos series, full-scale Spaceplane (?)

Stages: 2 (?)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
1st Stage	38.0m	5.0m	1	
2nd Stage	8.0	5.0		
Shroud		5.0	-	-
Overall	65.0	5.0		

	Designator	Fuel	Oxidizer	Burn Time
1st Stage		Kerosene	LOX	
2nd Stage				

Lift-off weight: 400,000 kg
Lift-off thrust: 600,000 kg
Payload capacity: 15,000 kg to LEO

Background: The SL-16 was first launched in 1985. It is a new medium-lift Titan IIIC class vehicle which will fill a gap in the Soviet inventory by providing an economical means of launching medium weight payloads into low earth orbit.

Sources: 11, 31, 32

SL-W

Launch Site: TT

Shuttle version payload: Soviet space shuttle

Heavy-lift version payload: large space station, components for manned inter-planetary missions, ballistic missile defense systems

Stages: 2 (central core plus 4 strap-on boosters)

Propellant: Liquid

	Length	Diameter	Main Engines	Main Nozzles
Core	60.0m	8.0m	4	?
Strap-ons (4)	38.0	5.0	4	?
Overall	60.0	18.0	8	?

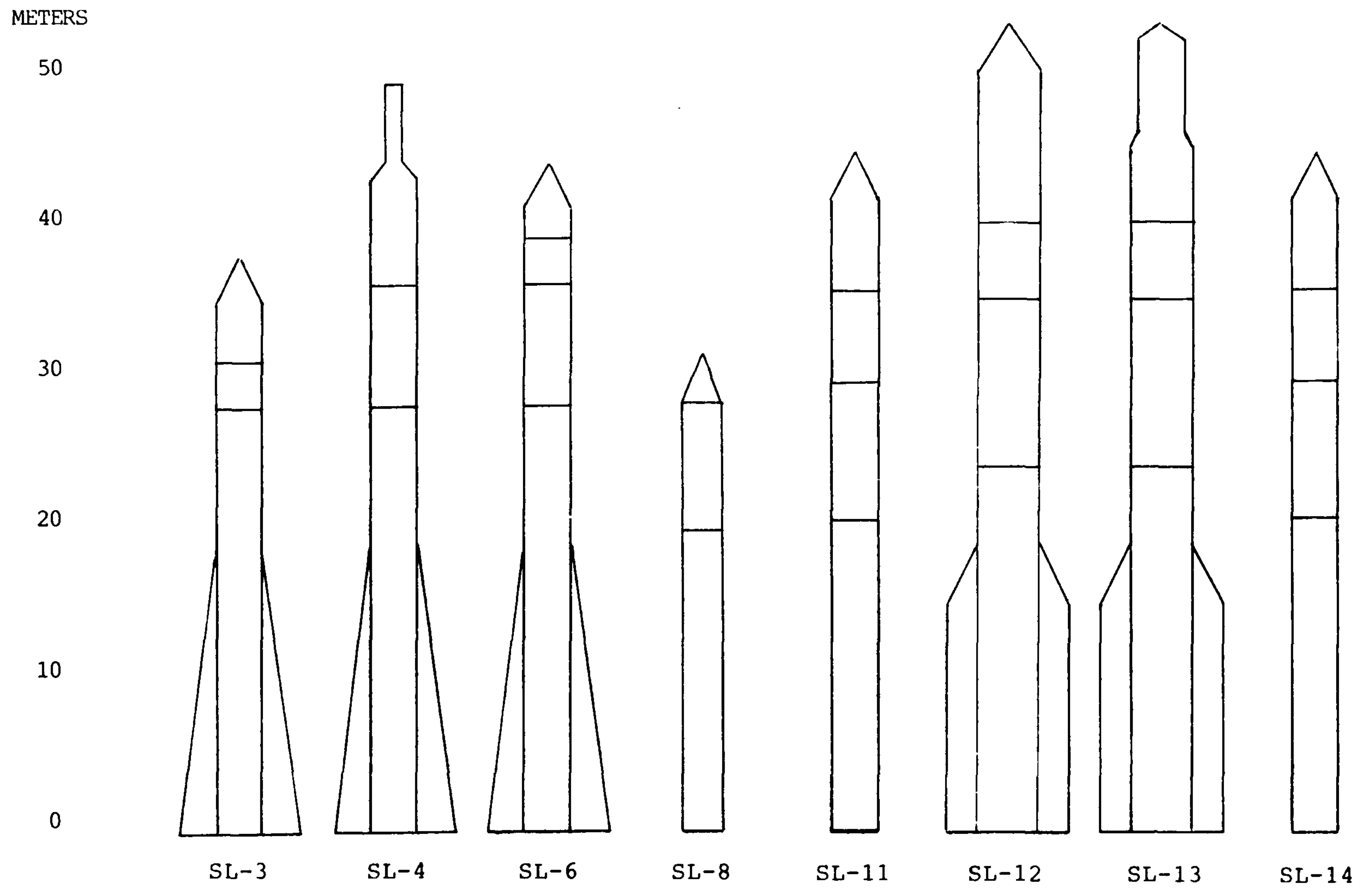
	Engine Designator	Fuel	Oxidizer	Burn Time
Core	?	LH_2	LOX	?
Strap-ons	?	Kerosene	LOX	?

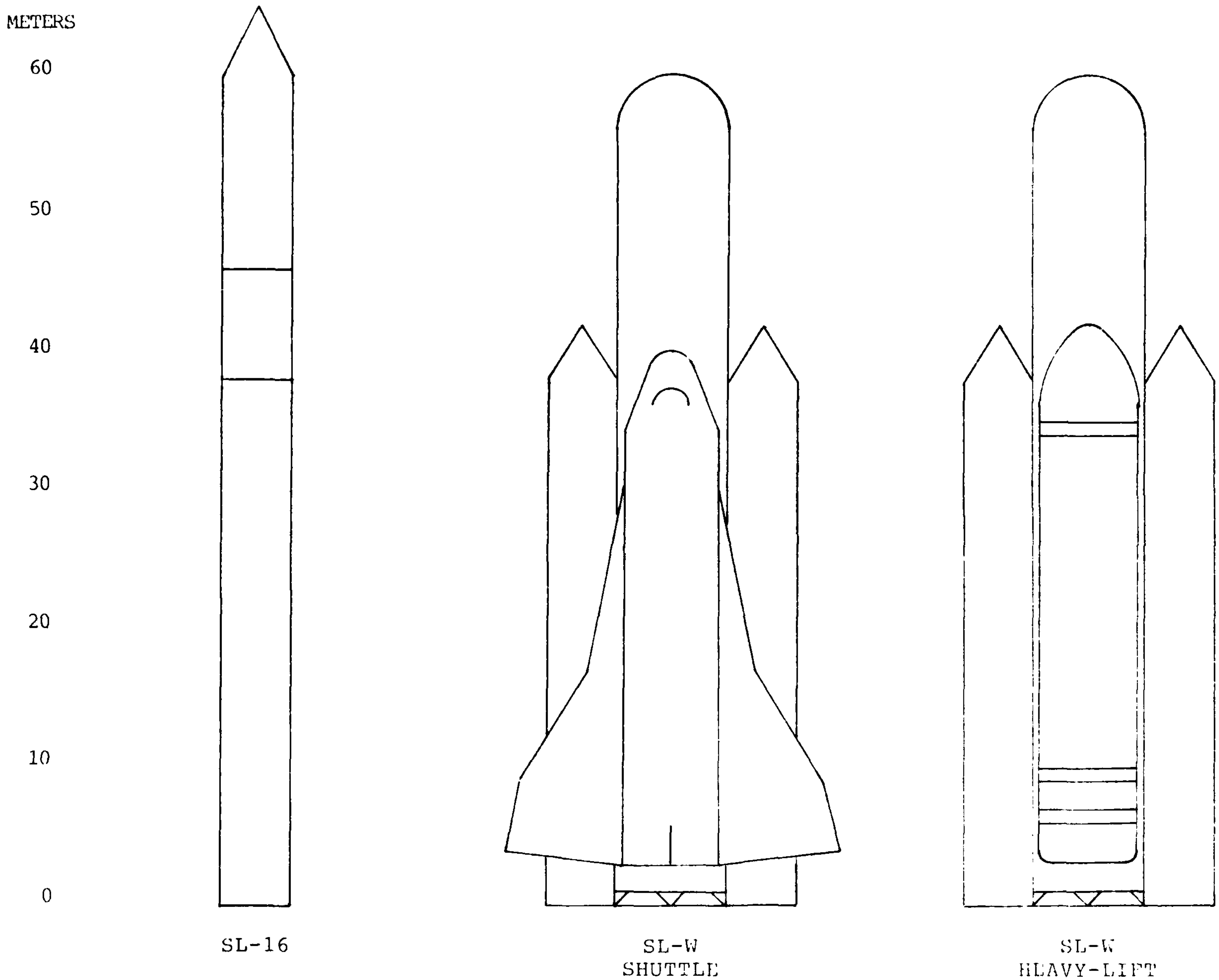
Lift-off weight: 2,000,000 kg
Lift-off thrust: 3,000,000 kg
Payload to LEO: 30,000 kg (shuttle version)
100,000 kg (heavy-lift version)

Background: The SL-W "Energia" (energy) was first launched in 1987. It is the first Soviet space launch vehicle to use cryogenic fuel. It differs from the US shuttle in that the main engines are located on the core vehicle rather than on the orbiter itself. This allows the SL-W to be used in two configurations: the shuttle version and a heavy-lift version. The heavy-lift version makes the SL-W a Saturn V class vehicle capable of placing an estimated 100,000 kg into low earth orbit. The SL-W is considered a two stage launch vehicle with four SL-16 first stage strap-on boosters making up the first stage and the central core serving as a second stage. Both stages ignite at launch.

Sources: 13, 31, 32

SPACE LAUNCH VEHICLES





METERS
60
50
40
30
20
10
0
SL-16
SL-W
SHUTTLE
SL-W
HEAVY-LIFT

SATELLITE PROGRAMS

ASAT

Launch Site: TT
Launch Vehicle: SL-11

Maneuverable: YES

Period: per target
Inclination: per target (65 deg in tests)
Altitude: up to 1500 km

The Soviet Union currently has the world's only operational antisatellite system. The first ASAT launch was in 1968. The last test was in June 1982 and since then the Soviets have observed a unilateral moratorium on ASAT testing.

Historically, the Soviets have practiced two scenarios: rev one and rev two intercepts. In both cases, the ASAT uses both radar and optical sensors to guide it to the target satellite. It destroys the target by moving in close and then exploding a conventional warhead which creates a multi-pellet blast. The blast destroys both the target and the ASAT itself. Intercepts occur over the western Soviet Union in the early hours of the morning local time.

The Soviet ASAT presents a distinct threat to low altitude US satellites.

Sources: 31, 32, 33, 34

ASAT TARGET

Launch Site: PK

Launch Vehicle: SL-8

Maneuverable: NO

Period: up to 115 min

Inclination: 65-66 deg

Altitude: up to 1500 km

Dimensions: approx 3.9 meters long and 2.1 meters in diameter

This is the test target vehicle for the Soviet ASAT program. (see ASAT)

Sources: 30, 34

BIOSAT

Launch Site: PK
Launch Vehicle: SL-4

Maneuverable: NO

Period: ~90 min
Inclination: 82.4 deg
Altitude: approx 220 x 280 km

Weight: approx 6000 kg

The Soviet BIOSAT program is designed to carry out multinational (including US) biological and physiological research to study the effects of spaceflight on living organisms. So far more than 50 different biological specimens have been flown into space on BIOSAT including a wide variety of animals, plant life, and microorganisms. The aim of the program is one of protecting astronauts from the long-term effects of spaceflight and discovering the limits of their tolerance.

Sources: 31, 33, 34

COS 929 TYPE

Launch Site: TT
Launch Vehicle: SL-13
First Launch: 1977

Maneuverable: YES

Period: ~89 min
Inclination: 51.6 deg
Altitude: 220 x 270 km

Dimensions: approx 13 meters long and 4 meters in diameter
Weight: approx 20,000 kg

COS 929 type space station modular components provide an additional 50 cubic meters of habitable volume to Soviet space station complexes. At 20,000 kg, they are approximately the same size as the space station itself. Four modules have been flown to date: Cosmos 929, 1267, 1443 and 1686. In March 1987, a fifth module, called KVANT and not assigned a Cosmos number, became the first add-on module for the MIR space station.

Sources: 17, 31

COS 1374 TYPE

SEE "SPACEPLANE"

COS 1426 TYPE

SEE "PHOTO RECON"

COS 1603 TYPE
HEAVY ELINT

Launch Site: TT
Launch Vehicle: SL-12
First Launch: 1984

Maneuverable: YES

Period: 102 min
Inclination: 71 deg
Altitude: 845-855 km

Weight: ~15,000 kg

Very little information is available on this new Soviet ELINT program. At 15,000 kg, it is one of the largest military satellites ever launched by the Soviets. Its orbit is quite different and considerable higher than the normal ELINT ferret missions flown out of Plesetsk. Its general mission characteristics, however, are assumed to be similar. (see ELINT)

Sources: 23, 31

COS 1700 TYPE
DATA RELAY SATELLITE
"LUCH"

Launch Site: TT
Launch Vehicle: SL-12

Maneuverable: YES

Period: ~1436 min
Inclination: near zero
Altitude: 36,000 km

The Soviet LUCH (beam) data relay satellite is almost identical to the US TDRS system. It operates in the 11-15 GHZ range and was first publicly acknowledged by the Soviets during live television transmissions from the MIR space station last year. This system will allow the Soviets to transmit and receive data between operational, LUCH-capable satellites and their associated ground stations in near real time. As of 1986, the Soviets had LUCH satellites at three geostationary locations: 95E, 200E, and 344E.

Sources: 3, 11, 12, 31, 32

EARLY WARNING

Launch Site: PK   Maneuverable: YES
Launch vehicle: SL-6

Period: 718 min
Inclination: 63 deg
Eccentricity: 0.7
Altitude: 400-36,000 km with apogee in the northern hemisphere

Constellation: 9 satellites
Phasing: 9 planes spaced 40 degrees apart
1 satellite per plane

Weight: approx 2000 kg

Soviet early warning satellites in Molniya orbits provide instantaneous alert of missile and space launches and nuclear detonations. Data from these satellites also allows rapid launch azimuth calculation and trajectory analysis. The test program for the current system began in 1972, with operational deployment starting in 1976, but an average launch rate of six satellites per year to maintain a nine satellite constellation indicates there may still be considerable technical problems with the program.

Sources: 10, 11, 12, 32, 33, 34

EARTH RESOURCES

Launch Site: PK
Launch Vehicle: SL-4

Maneuverable: YES

Period: ~90 min
Inclination: 82.3 deg
Altitude: 180-320 km

Earth Resources satellites use multi-spectral cameras to locate natural resource deposits, collect hydrogeological data, and monitor crop production. This information is not only of considerable value to their own economy, but also plays in their strategic assessment of other countries and allows them a stronger negotiating position in the world marketplace. The satellites cover the world in two degree longitude strips and fly a 14 day mission. The Soviet Earth Resources satellite is similar to the US Landsat.

Sources: 10, 11, 12, 31, 33, 34

EIGHT BALL

SEE "MULTIPLE PAYLOAD COMMUNICATIONS SATELLITE"

EKRAN

Launch Site: TT
Launch Vehicle: SL-12
First Launch: 1976

Mission: COMM
Maneuverable: YES

Period: ~1436 min
Inclination: near zero
Altitude: 36,000 km
Statsionar Location: 99E

Dimensions: approx 5 meters long and 2 meters in diameter
Weight: approx 2000 kg

The Soviet EKRAN (screen) satellite is designed for television relay between Moscow and Siberia. As displayed at the Paris Air Show, the satellite's transmitter consists of a flat plate supporting 96 small helix antennae. It has two large solar panels and an estimated operational life of two years.

Sources: 10, 11, 12, 31

ELINT

Launch Site: PK
Launch Vehicle: SL-14

Maneuverable: NO

Period: 98 min
Inclination: 82.5 deg
Altitude: 635 x 665 km

Constellation: 6 satellites
Phasing: 6 planes spaced 60 degrees apart,
1 satellite per plane

The mission of the Soviet ELINT (electronic intelligence) program is to intercept and collect data on enemy radar emissions. This provides valuable information on the enemy's electronic order-of-battle (EOB) such as location and identification of weapons systems and disposition of forces. Information provided by ELINT satellites can also be used for analysis of those radar systems and assessment of their capabilities and limitations so that tactics and countermeasures can be developed to defeat them.

Sources: 10, 11, 12, 31, 32

EORSAT
(ELINT Ocean Reconnaissance Satellite)

Launch Site: TT
Launch Vehicle: SL-11
First Launch: 1974

Maneuverable: YES

Period: 93 min
Inclination: 65 deg
Altitude: 425-445 km

The mission of the Soviet ELINT Ocean Reconnaissance Satellite (EORSAT) is to locate and identify ships at sea by monitoring their radio transmission frequencies and radar pulse patterns. Combined with radar imagery from RORSATs (Radar Ocean Reconnaissance Satellites), this provides the Soviets with a near realtime capability to locate US naval forces and target them for destruction by Soviet anti-ship weapons. As opposed to the RORSAT, which is nuclear powered and carries an active radar, EORSATs are conventionally powered and their mission is passive. Mission duration is approximately one year.

Sources: 10, 11, 12, 31, 32

FOBS
(Fractional Orbital Bombardment System)

Launch Site: TT
Launch Vehicle: SL-11
First Launch: 1966
Last Launch: 1971

Maneuverable: YES

Period: Suborbital
Inclination: Variable
Altitude: 160 km

The Soviets conducted 18 tests of a Fractional Orbital Bombardment Syetsm (FOBS) between 1966 and 1971. During these tests, simulated warheads would be flown 95 percent of the way around the world and then slowed by retros to re-enter over home territory just prior to the end of the first rev. An operational FOBS capability would be used in wartime to make a southerly attack on the United States -- as opposed to taking the more obvious northerly route. Fractional Orbital Bombardment Systems were banned by SALT-2, but even though the last FOBS test was in 1971, there is still considerable debate over whether the Soviets actually abandoned the program.

Sources: 31, 33, 34

GEODETIC

Launch Site: PK
Launch Vehicle: SL-14

Maneuverable: NO

Period: 116 min
Inclination: 73.6 deg
Altitude: 1500 km

The mission of Soviet geodetic satellites is to provide data on the size and shape of the earth for use in strategic missile targeting. Accurate missiles and accurate target locations are of limited use unless accompanied by equally accurate geodetic information. The Soviets normally launch one geodetic satellite per year.

Sources: 10, 11, 12, 31, 32, 33, 34

GLONASS
(Global Navigation Satellite System)

Launch Site: TT
Launch Vehicle: SL-12
First Launch: 1982

Mission: NAV
Maneuverable: YES

Period: 12 hrs
Inclination: 64.8 deg
Eccentricity: near zero
Altitude: 19,000 - 19,200 km

Constellation: 9 to 12 satellites
Phasing: 3 planes spaced 120 degrees apart
3 to 4 satellites per plane

The Soviet Global Navigation Satellite System is very similar to the US Global Positioning System (GPS). The only major difference is that the Soviet system will have only 9 to 12 satellites compared to the 18 to 24 for GPS. This will give GLONASS a worldwide, two dimensional capability. GPS on the otherhand will be able to provide three dimensions (the third being altitude) plus velocity.

GLONASS satellites are launched three at a time by a single SL-12 booster from Tyuratam. They provide a highly accurate, space-based global navigation system and their positioning data is used both by military and civilian users. GLONASS satellites use frequencies in the 1.2 to 1.6 GHz range.

Sources: 11, 12, 31, 32

GORIZONT

Launch Site: TT
Launch Vehicle: SL-12
First Launch: 1978

Mission: COMM
Maneuverable: YES

Period: ~1436 min
Inclination: near zero
Altitude: 35,785 km
Statsionar Locations: 14, 40, 53, 80, 140, 346E

Dimensions: 5 meters long and two meters in diameter cylindrical with two solar panels
Operational Life: approx 2 years

Gorizont (horizon) is a geostationary communications satellite designed primarily for international rather than domestic use. It is used for transmitting Izvestia, Pravda, and other Soviet newspapers to foreign countries and for international television relays such as in the case of the 1980 Moscow Olympics. In addition, Gorizont provides the backup hotline between Washington and Moscow.

Sources: 4, 10, 11, 12, 31

INTERCOSMOS

Launch Sites: KY, PK
Launch Vehicle: SL-8
First launch: 1969

Mission: Scientific
Maneuverable: NO

Intercosmos is the Soviet program for international cooperation and shared scientific experimentation in space. It has included a wide variety of upper atmospheric and solar studies and allows the other Soviet-bloc countries to participate in space research. The Soviets provide the basic satellite bus, but the experiment packages themselves are built and paid for by the other member nations. Scientific results are the common property of all Intercosmos members. Sweden and France are also major participants in the program.

Sources: 31, 33, 34

KVANT

SEE "COS 929 TYPE" SPACE STATION MODULE

LAUNCH DETECTION SYSTEM
(LDS)

SEE "EARLY WARNING"

METSAT

Launch Sites: PK, TT
Launch vehicles: SL-3, SL-14
First Launch: 1966

Mission: Weather
Maneuverable: NO

Dimensions: approx 5 meters long and 2 meters in diameter, cylindrical with two solar panels approx 10 meters in span

Weight: approx 2000 kg

Vehicle Description: Soviet METSAT's have a three axis stabilized attitude control system. They carry two television cameras, infrared sensors, radiometers, and an automatic picture transmission system for realtime coverage. Each camera has a resolution of about 1200 meters and they cover slightly overlapping swaths about 1000 km wide each.

Mission: In addition to the standard cloud cover photographs, METSAT's also report on atmospheric radiation, ocean ice packs, and snow cover on land. This information is used in weather forecasting, irrigation planning and maritime course plotting, etc. METSAT receiving stations are located at Moscow, Novosibirsk, and Kharbarovsk. Soviet METSAT's are roughly equivalent to our NOAA satellites.

METEOR-2

Launch Site: PK
Launch Vehicle: SL-3, SL-14
First Launch: 1975

Period: 104 min
Inclination: 82.6 deg
Altitude: 940-980 km

Meteors 2-1 thru 2-7 and 2-9 thru 2-10 were launched by SL-3's. Meteors 2-8 and 2-11 thru 2-13 were launched by SL-14's. The Soviets maintain two to three satellites in their Meteor-2 constellation.

METEOR-3

Launch Site: PK
Launch Vehicle: SL-14
First Launch: 1985

Period: 110 min
Inclination: 82.6 deg
Altitude: 1230-1250 km

Meteor-3's are similar to Meteor-2's except they are in higher orbits.

METEOR-PRIRODA

Launch Site: TT
Launch Vehicle: SL-3
First Launch: 1981

Period: 97 min
Inclination: 98 deg
Altitude: 560-660 km

Meteor-Priroda (nature) is the only Soviet program which uses a retrograde orbit -- in this case, a sun-synchronous orbit. It's mission is similar to our Landsat. It provides information on natural resources and is the first Soviet earth resources satellite capable of continuous imagery.

Sources: 10, 11, 12, 31, 33, 34

MINOR MILITARY

SEE "RADSAT"

MIR

Launch Site: TT
Launch Vehicle: SL-13
First Launch: 1986

Mission: Space Station
Maneuverable: YES

Period: 91 min
Inclination: 51.6 deg
Altitude: 320-360 km

Dimensions: 13.5 meters long and 4.2 meters maximum diameter

Habitable Volume: 90 cubic meters (core vehicle) with modular components providing an additional 50 cubic meters each

Weight: 20,000 kg

The new Soviet space station Mir (peace) was launched in February 1986. The most significant improvement over the old Salyut design is that while Salyut had just two docking ports, Mir has six: one forward, one rear, and four forward lateral. This then will allow the Soviets to use Mir as the core vehicle for a large modular space station. Modules can still only dock at the front or rear ports, but Mir is equipped with a large mechanical arm which is designed to take modules docked at the front port and move them through 90 degrees for redocking at a side port. Mir also has improved solar energy and electrical power systems. It was launched with two solar arrays each with an area of 38 square meters (76 total). Salyut, on the otherhand, had three solar arrays each with an area of 20 square meters (60 total). Then in 1987, a third solar array, carried into orbit by KVANT, was added to bring the total to 114 square meters -- nearly double the capacity of Salyut.

Mir has improved operations and control systems (two main engines and 32 smaller reaction control jets), considerably better computer capabilities, and expanded crew space -- including, for the first time, individual cabins for crewmembers. Most of the military and scientific work is designed to take place in the add-on modular components. Missions will include visual reconnaissance, astrophysical and biological research, and materials processing.

Sources: 4, 6, 17, 32

MOLNIYA

Launch Sites: PK, TT
Launch Vehicle: SL-6
First Launch: 1965

Mission: COMM
Maneuverable: YES

Period: 718 min
Inclination: 62.8 deg
Eccentricity: 0.7
Altitude: 400-36,000 km with apogee in the northern hemisphere

Background: The "Molniya" orbit is ideally suited to Soviet needs for two reasons. First, because of its high latitude, there are severe payload penalties (cost and weight) in launching to geosynchronous orbit from Tyuratam. And second, much of Soviet territory is too far north to be adequately serviced by equatorial orbits. Molniya orbits, on the other-hand, allow the satellites to spend approximately 75 percent of their time at high altitudes over the northern hemisphere.

Mission: Molniya is the primary Soviet satellite communications system. It supplies telephone and television service between over 100 "Orbita" ground stations located throughout the Soviet Union and Eastern Europe.

MOLNIYA-1

Constellation: 8 satellites
Phasing: 8 planes spaced 45 degrees apart
1 satellite per plane

Vehicle Description: The Molniya-1 series was first launched in 1965. The vehicle is cylindrical (3.4 meters long and 1.6 meters in diameter) with six solar panels in a windmill array. It weighs approximately 1000 kg and has two 0.9 meter steerable antennas which extend from the base. The solar panels generate 500 to 700 watts of power and the antennas have a gain of approximately 18 db.

MOLNIYA-3

Constellation: 8 satellites
Phasing: 4 planes spaced 90 degrees apart (these 4 planes coincide with 4 of the 8 Molniya-1 planes), 1 satellite per plane

MOLNIYA-3 (cont)

Vehicle Description: The Molniya-3 series was first launched in 1974. The principal difference between the Molniya-3 and the Molniya-1 is that the newer series operates at higher frequencies and has a color television capability (Molniya-1 does not). The Molniya-3 vehicle is cylindrical (4.2 meters long and 1.6 meters in diameter) and weighs approximately 1000 kg.

Sources: 10, 11, 12, 31, 32, 33, 34

MULTIPLE PAYLOAD COMMUNICATIONS SATELLITE
(Eight Ball)

Launch Site: PK
Launch Vehicle: SL-8
First Launch: 1970

Mission: COMM
Maneuverable: NO

Period: 115 min
Inclination: 74 deg
Altitude: 1500 km

Dimensions: 100 cm spheres
Weight: approx 40 kg each

These satellites are launched eight at a time by a single SL-8 booster. They are one of three Soviet store-dump satellite communications systems used for medium range transmissions between tactical forces. It takes 24 satellites to provide global coverage with this kind of system, but, to ensure redundancy, the Soviets prefer to maintain 38 to 48 active satellites in the constellation. The operational life of these satellites is about two years and it normally takes two to three launches per year to maintain the system. There are over 300 dead MPCS satellites still in orbit.

In a store-dump system, the sender transmits his message as the satellite passes overhead, and the satellite then stores the message until it comes within range of the receiving station. At that point, the satellite then retransmits (dumps) the message to the intended receiver. MPCS satellites operate in VHF and UHF frequency ranges.

Sources: 10, 11, 12, 31, 32

MULTIPLE PAYLOAD COMMUNICATIONS SATELLITE
(Six Pack)

Launch Site: PK
Launch Vehicle: SL-14
First Launch: 1985

Mission: COMM
Maneuverable: NO

Period: 114 min
Inclination: 82.6 deg
Altitude: 1380-1420 km

Weight: 100 kg each

This is the newest of the three Soviet store-dump, lower altitude, space-based communications systems -- MPCS (eight ball) and SPCS are the others. There were two six pack launches in 1985, none in 1986, and one in 1987. Using the SL-14 instead of the SL-8 allows these satellites to be more than twice the size of their eight ball counterparts (100 vs 40 kg each). The new orbit is designed to avoid interference from/with the still operational eight ball system.

Six pack is an improved store-dump system used for medium range VHF and UHF communications between tactical forces in the field. Using low power transmitters, the sender transmits his message as the satellite passes overhead. The satellite stores the message and then retransmits (dumps) it as it overflies the designated receiver.

These satellites are launched six at a time by a single SL-14 booster from Plesetsk.

Sources: 11, 31

NAVSAT

Launch Site: PK
Launch Vehicle: SL-8
First Launch: 1967

Maneuverable: NO

Period: 105 min
Inclination: 83 deg
Altitude: 965-1020 km

Constellation: (1) 6 satellites
(2) 4 satellites

Phasing: (1) 6 planes spaced 30 degrees apart
1 satellite per plane
(2) 4 planes spaced 45 degrees apart
1 satellite per plane

The Soviet NAVSAT program is similar to the US Transit system. It's a Doppler-based system used for navigation by ships, submarines, and aircraft. Its operating frequencies are 150 and 400 MHz and it employs two separate constellations to ensure continuous availability. NAVSAT's weigh approximately 700 kg each.

The method involves receiving a navigational beacon from the satellite and measuring the Doppler shift to determine the relative positions of the receiver and the satellite. The satellite also sends out periodic ephemeris on its position and a computer on the receiving vessel can then compare the positional data with the Doppler shift to determine its own location. Accuracy is about 50 meters.

Sources; 10, 11, 12, 31, 32, 33, 34

PHOTO RECONNAISSANCE

Launch Sites: PK, TT Maneuverable: YES
Launch Vehicle: SL-4

Mission: High resolution photography of areas of interest throughout the world.

Background: With an average launch rate of 27 satellites per year (not including earth resources satellites), this is the largest single component in the Soviet space program.

Generation 3

Launch Sites: PK, TT
First Launch: 1968

Period: 92 min
Inclinations: 65 (TT), 70 (TT), 73 (PK)
Altitude: 220-380 km

Weight: approx 5900 kg

Mission Duration: 14 days

Background: Generation 3 photo reconnaissnace satellites have generally lower resolution and cover the world in two degree longitude strips.

Note: See "Earth Resources" for 82.3 degree inclination photo reconnaissance satellites launched from Plesetsk.

Generation 4

Launch Sites: PK, TT
First Launch: 1975

Period: 89-90 min
Inclinations: 65 (TT), 67 (PK), 71 (TT)
Altitude: 170-350 km

Weight: approx 6700 kg

Mission Duration: 54-55 days

Background: Generation 4 photo reconnaissance satellites carry six (?) recoverable film capsules and are powered by solar panels.

Generation 5 (Cos 1426 Type)

Launch Site: TT
First Launch: 1982

Period: 91 min
Inclination: 65 deg
Altitude: 200-400 km

Mission Duration: 200-300 days

Background: Generation 5 photo reconnaissance satellites use a digital imaging system and relay satellites to provide a near real-time reconnaissance capability.

Sources: 10, 11, 12, 31, 32, 33, 34

PROGNOZ

Launch Site: TT
Launch Vehicle: SL-6
First Launch: 1972

Mission: Scientific
Maneuverable: NO

Period: 4-27 days
Inclination: 65 deg
Perigee: 400-500 km
Apogee: 100,000-720,000 km (well beyond the moon)

Vehicle Description: spherical with 4 solar panels
Weight: approx 900 kg

The Prognoz (forecast) series are high eccentricity satellites designed for scientific research. They measure solar weather phenomena and their interaction with the earth. They collect data on the magnetosphere, solar radiation, and physical processes taking place on the sun and their effects on space-based communications systems. Launch rate is about one every two years.

Sources: 31, 34

PROGRESS

Launch Site: TT
Launch Vehicle: SL-4
First Launch: 1978

Mission: Man-Related
Maneuverable: YES

Period: 88-92 min
Inclination: 51.6 deg
Altitude: 200-360 km

Dimensions: 7.94 meters long and 2.2 to 2.7 meters in diameter
Weight: approx 7000 kg

Progress is the unmanned resupply vehicle for Soviet space station complexes. It's derived from the Soyuz design and very similar to it in appearance. The major differences are the lack of solar panels and heat shielding. In addition, since it's unmanned, an emergency escape system is not required for launch, and all these factors combined make it possible for Progress to carry 2300 kg of cargo (nearly one third of its liftoff weight) into orbit. About 1000 kg of that cargo is fuel, with the remainder being air, food, water, etc. Since each cosmonaut consumes approximately 15 to 30 kg of materials per day, a new Progress mission is required every four to six weeks the space station is occupied. Fuel transfers can be performed either by the Salyut crew or by ground control and this feature allows the space station to be refueled even during times when it's unmanned.

After Progress has docked with the Soyuz/Salyut complex, the cosmonauts unload the new provisions and then reload Progress with waste material. This role as a garbage scow is almost as important as its role as a cargo ship. In the days prior to Progress, the crews had to eject their waste packages through airlocks and they took a long time to drift clear and tended to pollute their immediate environment. After the reloading process is complete, Progress' engines are used to boost the Soyuz/Salyut complex to a higher orbit and, once that's completed, Progress is then sent on a destructive re-entry course and burns up in the atmosphere.

Sources: 8, 31

RADSAT
(Radar Calibration Satellite)

Launch Sites: KY, PK
Launch Vehicle: SL-8

Maneuverable: NO

Period: 94 min
Inclinations: 51, 66, 74, 83 deg
Altitude: 470-520 km

Soviet radar calibration satellites (RADSAT's) are used for calibrating ground based radars. Some RADSAT's release clusters of small objects thought to simulate incoming re-entry vehicles. Many sources discuss RADSAT's under the heading of "Minor Military."

Sources: 10, 11, 12, 31, 33, 34

RADUGA

Launch Site: TT
Launch Vehicle: SL-12
First Launch: 1975

Mission: COMM
Maneuverable: YES

Period: 1436 min
Inclination: near zero
Altitude: 36,000 km
Statsionar Locations: 35, 45, 85, 128, 335E

Raduga (rainbow) is one of three Soviet geosynchronous satellite communications programs. Its mission is telephone and telegraph communications plus both black and white and color television relay between Moscow Central Television and the Orbita ground station network. Raduga is three axis stabilized and has an operational life of about two years.

Sources: 10, 11, 12, 31

RORSAT
(Radar Ocean Reconnaissance Satellite)

Launch Site: TT
Launch Vehicle: SL-11
First Launch; 1967

Maneuverable: YES

Period: 90 min
Inclination: 65 deg
Altitude: 250-265 km

Constellation: 2 satellites
Phasing: Coplanar

The Soviet RORSAT is a nuclear powered system that uses active radar to detect, locate, and target enemy naval forces. Since, in wartime conditions, naval vessels would operate under radio silence and maneuver to stay under cloud cover whenever possible, this system is designed to use powerful pulsed radar signals to penetrate clouds and give the Soviets an all weather space-based capability to locate our forces and target them for destruction by anti-ship weapons launched from Soviet platforms. The US has no comparable system.

RORSAT's usually operate in pairs and their normal mission duration is 60 to 70 days. They are powered by a radioisotope thermal generator containing 50 kg of U235. At the end of their mission, the six meter long reactor is separated and boosted into a 950 km storage orbit (600 year re-entry). In 1978, this system failed and Cosmos 954 decayed over Canada spreading radioactive debris in its path.

Sources: 10, 11, 12, 31, 32, 33, 34

SALYUT

Launch Site: TT
Launch Vehicle: SL-13
First Launch: 1971

Mission: Space Station
Maneuverable: YES

Period: 88-92 min
Inclination: 51.6 deg
Altitude: 200-360 km

Dimensions: 15 meters long and 4.15 meters maximum diameter
Weight: approx 20,000 kg

The Salyut space station has two docking ports, one forward and one rear, and approximately 100 cubic meters of habitable volume (Skylab, by comparison, had 357 cubic meters). Salyut has three solar panels: two horizontal and one vertical. Each solar panel has an area of 20 square meters and they have a combined power output of about 4 kW.

Missions include materials processing; earth resource surveys; astronomical, medical, and biological research; and various military-related tasks. Salyut carries a 650 kg telescope with multi-spectral camera and two furnaces -- one for smelting metals and the other for growing crystals.

Salyut 7 was last visited in 1986, when cosmonauts cocooned its major systems and dismantled much of its equipment and transferred it to the new Mir space station. The Soviets have no plans to reoccupy the Salyut in the near future.

Sources: 31, 32, 34

SHUTTLE

Launch Site: TT
Launch vehicle: SL-W

Mission: Manned
Maneuverable: YES

The Soviet shuttle is very similar to the US shuttle. Its development depended heavily on US propulsion, computer, materials, and air frame technology which allowed the Soviets to produce their shuttle years earlier and at much less cost than they would have been able to do otherwise. The main difference between the two shuttles is that, with the Soviet version, the main engines are on the central core of the SL-W launch vehicle and not on the orbiter itself. This gives their shuttle greater payload capacity and also allows them to use the SL-W in two configurations: the standard shuttle configuration and an independent heavy-lift configuration. (see SL-W)

Sources: 4, 13, 14, 32

SINGLE PAYLOAD COMMUNICATIONS SATELLITE

Launch Site: PK
Launch Vehicle: SL-8
First Launch: 1970

Mission: COMM
Maneuverable: NO

Period: 101 min
Inclination: 74 deg
Altitude: 800 km

Constellation: 3 satellites
Phasing: 3 planes spaced 120 degrees apart
1 satellite per plane

Weight: 875 kg

This program is one of three Soviet store-dump, low altitude, space-based communications systems. It is used for medium and long range military communications between tactical forces. The operational life of these satellites is about 12 to 18 months and it takes usually three launches per year to maintain the system.

With a store-dump system, the sender transmits his message as the satellite passes overhead, and the satellite then stores the message until it comes within range of the receiving station. At that point, the satellite then retransmits (dumps) the message to the intended receiver.

Sources: 10, 11, 12, 31, 32, 33, 34

SIX PACK

SEE "MULTIPLE PAYLOAD COMMUNICATIONS SATELLITE"

SOYUZ

Launch Site: TT
Launch Vehicle: SL-4
First Launch: 1967

Mission: Manned
Maneuverable: YES

Period: 88-92 min
Inclination: 51.6 deg
Altitude: 200-360 km

Dimensions: 10.36 meters long and 2.29 to 2.97 meters in diameter
Weight: approx 6000 kg

The Soyuz (union) spacecraft is the workhouse of the Soviet manned space program. It is comparable to the US Apollo. The mission of the Soyuz program has been the general advancement of Soviet manned space flight technology including maneuvering and docking techniques, engineering and biological research, and the assembly of manned orbital space stations.

The Soyuz vehicle consists of three compartments:

(1) Orbital Compartment (front): Used as a workshop and for resting while in orbit.

(2) Re-entry or Landing Module (center): Unlike the pre-shuttle US manned space flight vehicles which returned to earth by sea, Soyuz returns by land. A single main parachute is deployed at 8000 meters and retro-rockets fire at 0.9 meters. Landing velocity is approximately 3 m/sec.

(3) Instrument Compartment (rear): Similar in function to the Apollo service module in that it's not accessible to the cosmonauts. Contains main electrical, computer, and communications systems. Also contains the two primary maneuvering engines, each with a thrust of 400 kg, used for orbit adjusts and braking for re-entry.

Note: The orbital and instrument compartments are both jettisoned prior to re-entry.

The Soyuz-version SL-4 is fitted with an escape tower capable of lifting the orbital and re-entry compartments clear of the pad in case of an emergency. This system proved its worth in 1983, when a fire developed at the base of the booster and the cosmonauts on board Soyuz-10A were jettisoned free just seconds prior to the explosion.

There have been three different series in the Soyuz program:

(1) Soyuz -- the original, two man, series ended in 1982 with Soyuz-40

(2) Soyuz-T -- three man version first flown in 1979

(3) Soyuz-TM -- modernized version of the Soyuz-T series first launched in 1986. It has an improved docking system, a new communications system which allows communications with Moscow via LUCH data relay satellites, and a stronger and lighter parachute system which allows it to carry 200 kg more into orbit and return 150 kg more back to earth.

Sources: 8, 10, 11, 12, 31, 33, 34

SPACEPLANE
(COS 1374 TYPE)

Launch Site: KY
Launch Vehicle: SL-8
First Launch: 1982

Mission: Experimental
Maneuverable: YES

Period: 88 min
Inclination: 50.7 deg
Altitude: 160-220 km

Dimensions: subscale test vehicle
Weight: approx 1000 kg

Subscale orbital testing of the Soviet spaceplane program began with the launch of Cosmos 1374 in 1982. It closely resembles the Dyna-Soar type lifting bodies flown by NASA in the mid-1960's. To date, two mission profiles have been flown: a 1¼ revolution flight with re-entry in the Indian Ocean and a one rev scenario with re-entry in the Black Sea. These test flights are thought to be part of the development program for a full-scale spaceplane possibly launched on the new SL-16 medium-lift booster.

Potential missions for a full-scale version include: Soyuz replacement for space station crew rotation; delivery or retrieval of small but urgent payloads; quick reaction, real time reconnaissance; friendly satellite repair and maintenance; and foreign satellite inspection, and potentially, negation. Testing of a full-scale spaceplane could begin before the end of the decade.

Sources: 31, 32

STATSIONAR

Launch Site: TT	Mission: COMM
Launch Vehicle: SL-12	Maneuverable: YES
First Launch: 1975	

Period: approx 1436 min
Inclination: near zero
Altitude: ~36,000 km

Statsionar is the series designation for Soviet geostationary communications satellite programs. There are currently 13 operational Statsionar locations:

14E	Gorizont
35E	Raduga
40E	Gorizont
45E	Raduga
53E	Gorizont
80E	Gorizont
85E	Raduga
90E	Gorizont
99E	Ekran
128E	Raduga
140E	Gorizont
335E	Raduga
346E	Gorizont

The short term Soviet objective appears to be to have two satellites (one operational and one backup) at each location. In the long term, they have filed with the International Frequency Registration Board for 100 satellites at 25 locations.

See: Ekran, Gorizont, Raduga

Sources: 10, 11, 12, 31

VENERA

Launch Site: TT
Launch Vehicle: SL-12

Mission: Interplanetary
Maneuverable: YES

Venera probes are usually launched five days apart and operated in pairs so their transmissions can be compared. Their mission is exploration of the planet Venus including atmospheric analysis, details on the physical and chemical contents of the cloud layers, radar terrain mapping, and photography.

The spacecraft weigh approximately 3000-4000 kg each. Some missions have both an orbiter and a lander, in which case the lander is about one third the total payload weight and built to withstand temperatures and pressures on the order of 500 degrees centigrade and 100 atmospheres.

Sources: 31, 33, 34

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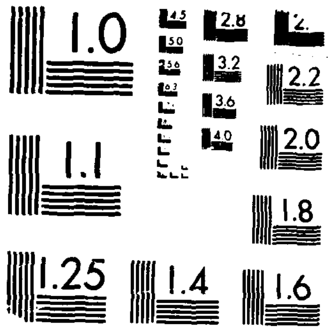


MICROCOPY RESOLUTION TEST CHART

URFAU STANDARDS 1963 A

APPENDIX

SPACE LAUNCH SUMMARY

1980-1987

	80	81	82	83	84	85	86	87
USSR								
Successful launches:	89	98	101	98	97	98	91	95
Total payloads placed in orbit:	(110)	(124)	(119)	(116)	(115)	(119)	(114)	(111)
USA								
Successful launches:	13	18	18	22	22	17	6	8

Differences between the number of successful launches and the number of payloads to achieve orbit can be accounted for as follows: (1) single SL-12 launches placing three GLONASS payloads in orbit, (2) single SL-8 launches placing eight MPCS payloads in orbit, and (3) single SL-14 launches placing six upgraded MPCS payloads in orbit.

Sources: 9, 19, 20, 21, 24, 27, 28, 29, 30

MISSION SUMMARY

	80	81	82	83	84	85	86	87
ASAT	1	2	1	-	-	-	-	-
ASAT TARGET	1	1	1	-	-	-	-	-
COMM	13	18	19	18	16	17	19	27
EARLY WARNING	7	5	5	3	7	7	7	3
EARTH RESOURCES	9	10	9	13	10	6	6	3
ELINT	4	2	5	7	3	9	6	7
EORSAT	2	3	3	1	2	3	3	4
GEODETIC	-	1	-	1	1	1	2	1
MANNED	6	3	3	2	3	2	1	3
MAN-RELATED	4	2	5	6	6	4	3	8
NAVIGATION	7	5	9	9	10	7	8	12
RADSAT	4	4	5	6	4	3	2	3
RECON	25	28	26	26	27	28	27	27
RORSAT	1	3	3	1	2	2	2	2
SCIENTIFIC	3	8	3	4	3	2	3	7
SPACE STATION	-	-	1	-	-	-	1	-
UNKNOWN	-	1	1	-	2	3	-	2
WEATHER	2	2	2	1	1	4	1	2

Sources: 9, 19, 20, 21, 24, 27, 28, 29, 30

LAUNCH VEHICLE CONVERSION TABLE

DOD	SHELDON*
SL-3	A1
SL-4	A2
SL-6	A2e
SL-8	C1
SL-11	F1
SL-12	D1e
SL-13	D1
SL-14	F2
SL-16	
SL-W	

* Identification system developed by Dr. Charles Sheldon of the Library of Congress. This is the system used in most civilian publications.

LAUNCH AZIMUTH VS INCLINATION

Once the launch azimuth of a new Soviet satellite is known, the inclination can be determined as follows:

$$\boxed{\cos INC = (\sin LAZ)(\cos LAT)}$$

where LAZ is the launch azimuth and LAT is the latitude of the launch site. The latitudes of the three Soviet launch sites are:

Kapustin Yar	N48.4
Plesetsk	N62.8
Tyuratam	N45.6

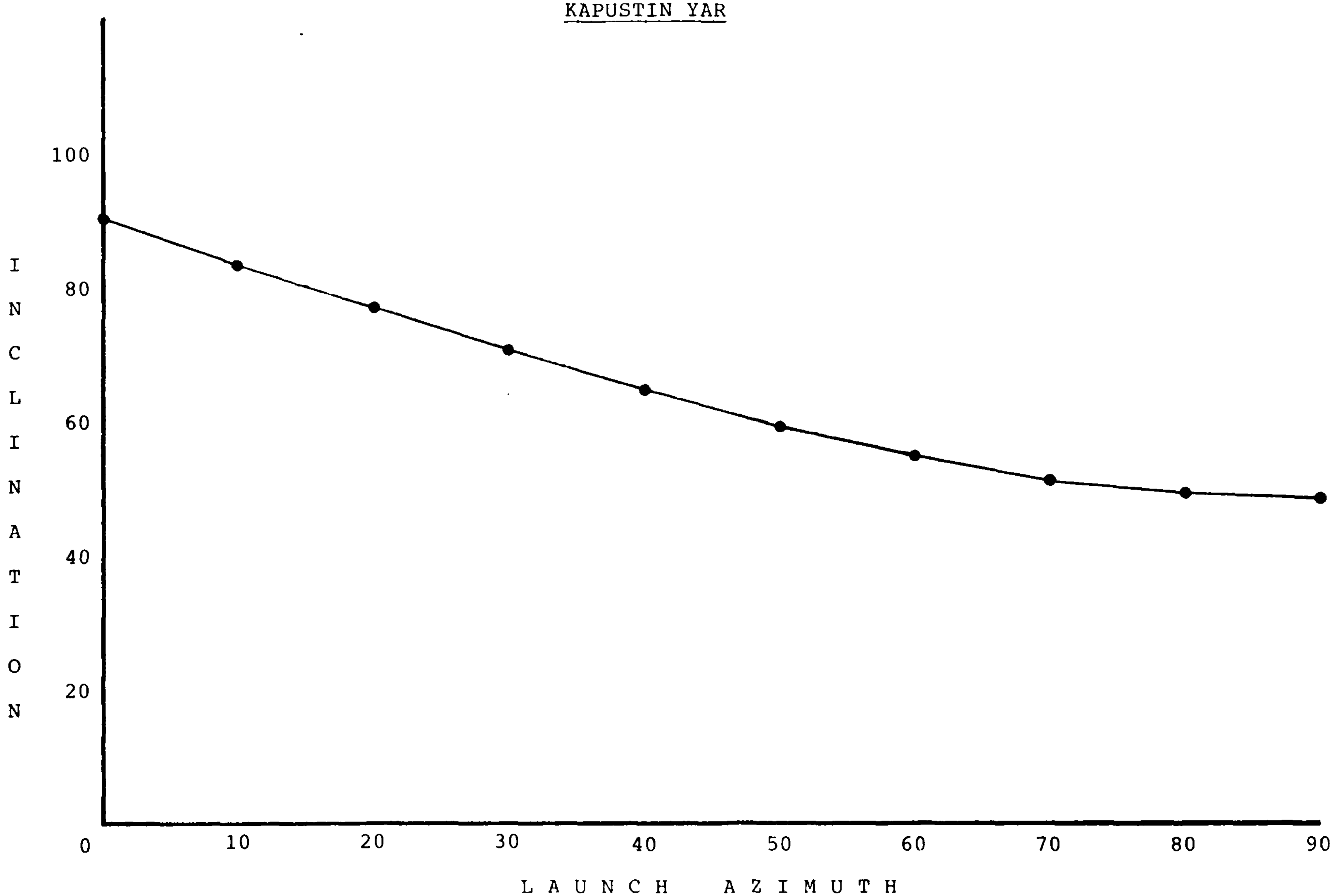
Several points are worth mentioning regarding this equation:

(1) There are two possible launch azimuths for each inclination. Due to geopolitical considerations however, launch azimuths will for the most part be limited to the first quadrant. The Chinese and West Europeans would probably not take too kindly to certain second, third and fourth quadrant solutions.

(2) The equation and accompanying graphs illustrate that the minimum, direct launch, inclination for a given launch site is equal to the latitude of the site. Inclination changes are extremely expensive in terms of delta velocity required and this puts the Soviet Union at a distinct disadvantage in regards to launching into equatorial orbits. This is also one of the main reasons the European Space Agency launch site is located in French Guiana.

(3) Retrograde and non-nominal launches are infrequent and should be dealt with by applying the equation directly.

KAPUSTIN YAR



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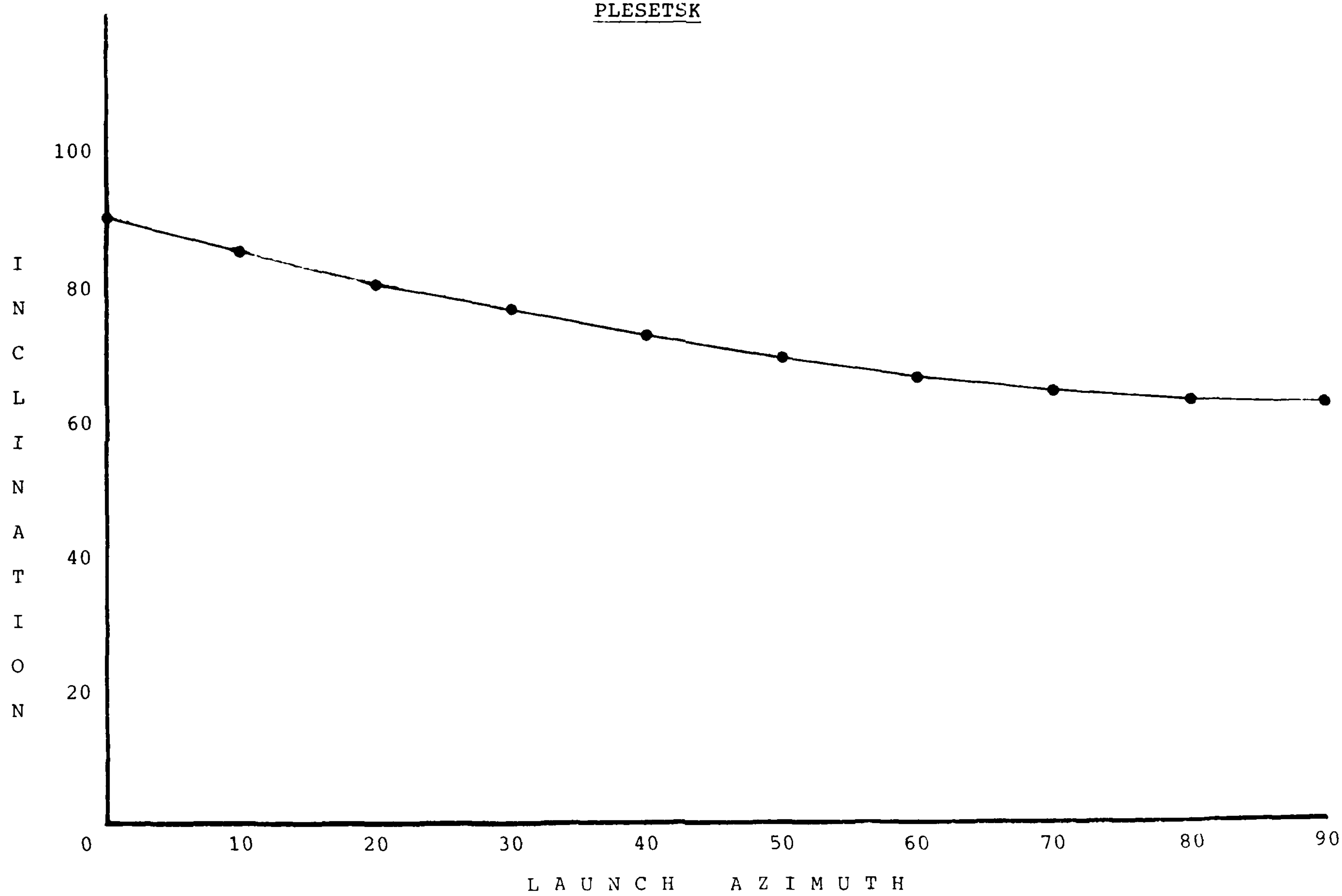
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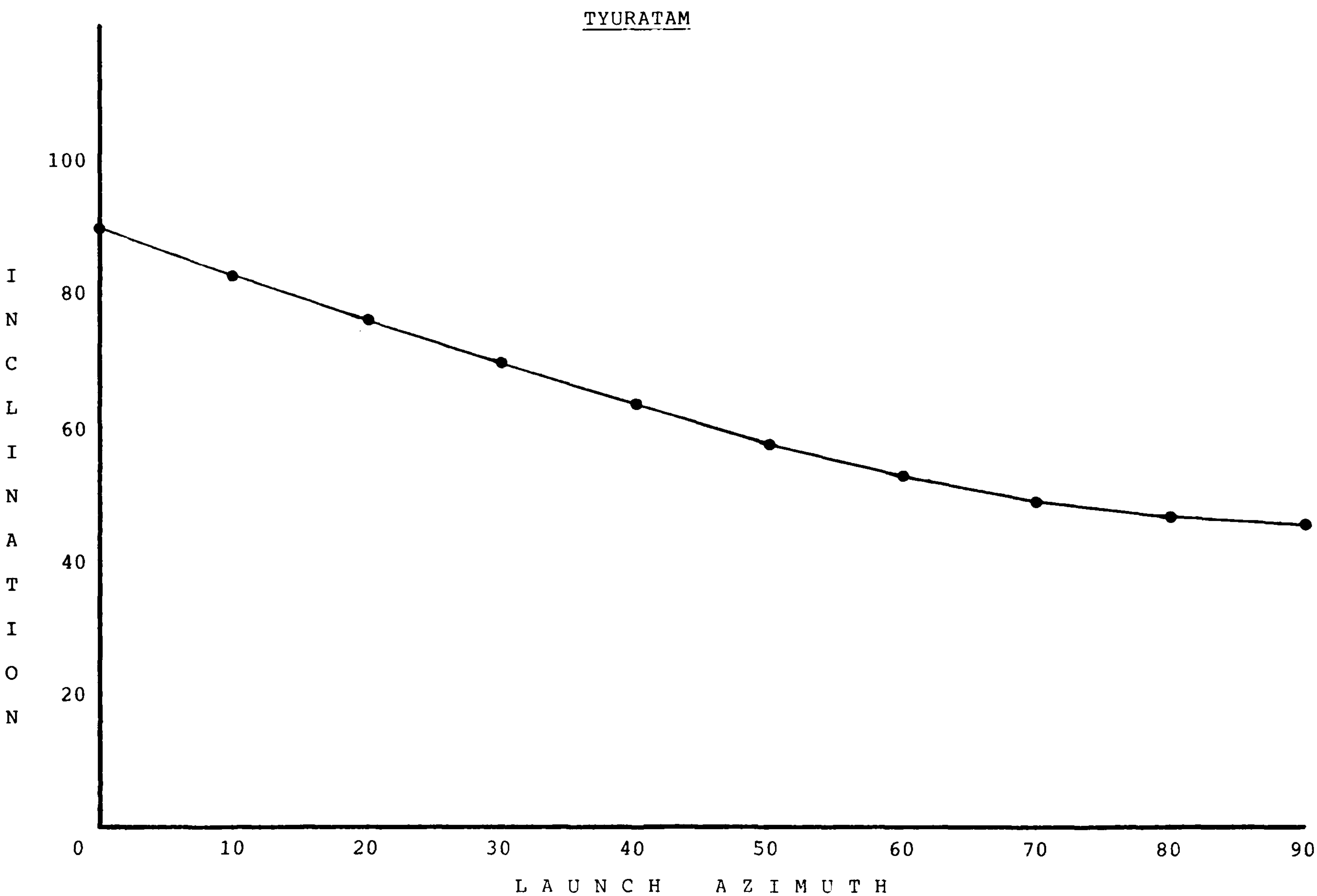
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L A U N C H   A Z I M U T H

GEOSYNCHRONOUS COVERAGE

Geosynchronous satellite coverage (X) at any given latitude can be determined as follows:

$$X = 2 \text{ arc cos } \frac{\cos Y}{\cos LAT}$$

where,

LAT = latitude

$$Y = 90 - E \text{ arc sin } \left[\frac{r_1}{r_2} \sin(90 + E) \right]$$

where,

E = minimum elevation

r_1 = mean radius of the earth (6370.88km)

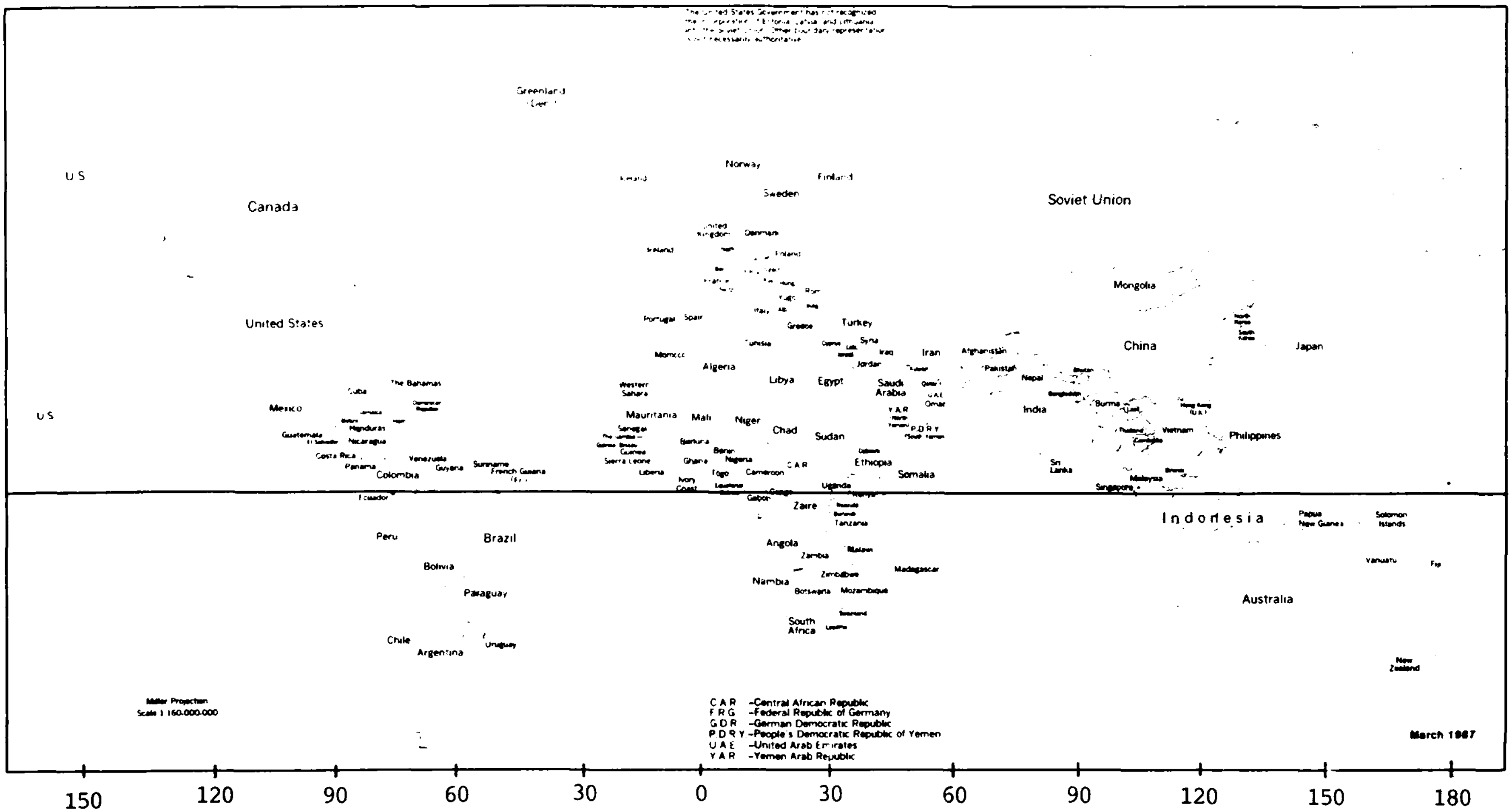
r_2 = radius of geosynchronous satellite orbit (42,162.96km)

EXAMPLE:

Given E = 0, X = 81.3092

Given E = 5, X = 76.3426

GEOSYNCHRONOUS COVERAGE



MISSION REFERENCE TABLE

PROGRAM	MISSION
ASAT	SPACE CONTROL
ASAT TARGET	ENGINEERING TEST
BIOSAT	MAN RELATED
COS 929 TYPE	MAN RELATED
COS 1374 TYPE	ENGINEERING TEST
COS 1426 TYPE	IMAGERY
COS 1603 TYPE	ELINT
COS 1700 TYPE	COMM
EARLY WARNING	ATTACK WARNING
EARTH RESOURCES	SCIENTIFIC
EIGHT BALL	COMM
EKRAN	COMM
ELINT	ELINT
EORSAT	OCEAN RECON
FOBS	FORCE APPLICATION
GEODETIC	CARTOGRAPHY/GEODESY
GLONASS	NAVIGATION
GORIZONT	COMM
INTERCOSMOS	SCIENTIFIC
KVANT	MAN RELATED
LDS	ATTACK WARNING
LUCH	COMM
METSAT	WEATHER

MISSION REFERENCE TABLE
(CONT)

PROGRAM	MISSION
MIR	MAN RELATED
MOLNIYA	COMM
MPCS	COMM
NAVSAT	NAVIGATION
PHOTO RECON	IMAGERY
PROGNOZ	SCIENTIFIC
PROGRESS	MAN RELATED
RADSAT	CALIBRATION
RADUGA	COMM
RORSAT	OCEAN RECON
SALYUT	MAN RELATED
SHUTTLE	MAN RELATED
SIX PACK	COMM
SOYUZ	MAN RELATED
SPACEPLANE	ENGINEERING TEST
SPCS	COMM
STATSIONAR	COMM
VENERA	SCIENTIFIC

GLOSSARY

ASAT - anti-satellite

BIOSAT - biological satellite

COMINT - communications intelligence

COS - Cosmos

ELINT - electronic intelligence

EORSAT - ELINT Ocean Reconnaissance Satellite

ESV - earth satellite vehicle

EVA - extravehicular activity

FOBS - Fractional Orbital Bombardment System

GLONASS - Global Navigation Satellite System

GPS - Global Positioning System

ICBM - intercontinental ballistic missile

IRBM - intermediate range ballistic missile

kg - kilogram

km - kilometer

KY - Kapustin Yar

LDS - Launch Detection System

LEO - low earth orbit

LH_2 - liquid hydrogen

LOX - liquid oxygen

METSAT - meteorological satellite

MPCS - Multiple Payload Communications Satellite

NAVSAT - navigational satellite

PK - Plesetsk

P/L - payload

RADSAT - radar calibration satellite

RORSAT - Radar Ocean Reconnaissance Satellite

SIGINT - signals intelligence

SL - space launch

SLV - space launch vehicle

SPCS - Single Payload Communications Satellite

SS - surface to surface

TT - Tyuratam

UDMH - unsymmetrical dimethylhydrazine

UHF - ultrahigh frequency

VHF - very high frequency

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